CLAIMS

1. A method for real-time determination of the mass of particles present in a particle filter (3) installed in the exhaust line (2) of an internal combustion engine (1), characterized in that the following sequence of operations is repeated at determined time intervals Δt:

(i) at the instant t, the temperature $T(t)$ of the exhaust gases at the inlet of the particle filter (3) is measured using a temperature sensor (5),

(ii) at the instant t, the operating parameters (Ne, Q) of the engine are measured by means of sensors (6, 7),

(iii) at the instant t, there are read, from pre-established tables, as a function of the operating parameters (Ne, Q) of the engine, the values of the following parameters: oxygen concentration $[O_2(t)]$ and nitrogen oxides concentration $[NO_x(t)]$ of the exhaust gases entering the particle filter, and the rate $F(t)$ of emission of particles from the engine,

(iv) at the instant t, using the kinetic laws of chemical reactions of combustion of particles, there is calculated the rate $V(t)$ of combustion of the particles in the particle filter by means of the following parameters: temperature $T(t)$, concentrations $[O_2(t)]$, $[NO_x(t)]$ of oxidizing agents, and mass $m(t - \Delta t)$ of particles present in the filter, obtained during the preceding cycle of operations at the instant $t - \Delta t$,

(v) at the instant t, there is calculated the mass $m(t)$ of particles present on the filter, using the mass $m(t - \Delta t)$ of particles obtained during the preceding cycle of operations according to the following formula:

$$m(t) = m(t - \Delta t) + [F(t) - V(t)] * \Delta t,$$

where Δt is the time interval between the instants $t - \Delta t$ and t,

(vi) the value calculated at the instant t for the mass $m(t)$ of particles present on the filter is recorded so that it can be used in the following sequence of operations at the instant $t + \Delta t$.

2. A method according to claim 1, characterized in that one or more values of the parameters $[O_2(t)]$, $[NO_x(t)]$, $F(t)$ is or are obtained by measurement with sensors instead of by reading from pre-established tables.

3. A method according to claim 1 or 2, characterized in that, for calculation of the rate $V(t)$ of combustion, there are considered the reactions of combustion of the particles by the nitrogen oxides NO_x and oxygen O_2, the rate of combustion being the sum of the rates of the reactions of combustion of the particles by the nitrogen oxides (V_{NO_x}) and oxygen

(V_{O_2}):

$$V(t) = V_{NO_x} + V_{O_2},$$

where:

$$V_{NO_x} = K_1 e^{Ea1/RT(t)} \times [m(t - \Delta t)]^{a1} \times [NO_x(t)]^{b}$$

$$V_{O_2} = K_3 e^{Ea3/RT(t)} \times [m(t - \Delta t)]^{a3} \times [O_2(t)]^{d}$$

where $T(t)$, $[O_2(t)]$, $[NO_x(t)]$ are determined during the preceding operation (iii), $a1$, $a3$, b and d are partial orders of the combustion reactions, and $Ea1$ and $Ea3$ are activation energies of the reactions of combustion by the nitrogen oxides and oxygen respectively.

4. A method according to claim 3, in which the particle filter contains an active phase for catalyzing combustion of the particles, characterized in that, during calculation of the rate of combustion, there is additionally considered the reaction of combustion of the particles by the oxygen present in the active phase of the particle filter, the rate of combustion being the sum of the rates of the reactions of combustion of the particles by the nitrogen oxides (V_{NO_x}), by oxygen (V_{O_2}) and by the oxygen of the active phase ($V_{O_{2catalyst}}$):

$$V(t) = V_{NO_x} + V_{O_2} + V_{O_{2catalyst}}$$

where $V_{O_{2catalyst}} = K_2 e^{Ea2/RT(t)} \times [m(t - \Delta t)]^{a2} \times [O_{2catalyst}(t)]^{c}$

where $[O_{2catalyst}(t)]$ is the concentration of oxygen in the active phase of the filter at the instant t, read from a table pre-established during a preceding operation as a function of the operating parameters (Ne, Q) of the engine, $a2$ and c are partial orders, and $Ea2$ is the activation energy of the reaction of combustion by the oxygen of the active phase.

5. A method according to one of claims 1 to 4, characterized in that, at the initial instant t_i, the mass $m(t - \Delta t)$ of particles present in the filter and used in operations (iv) and (v) is replaced by a mass ($m_{pressure}(t_i)$) of particles present in the filter, estimated by measuring the head loss between the inlet and outlet of the filter at the instant t_i.

6. A method according to claim 5, characterized in that the mass ($m_{pressure}$) of particles present in the filter, estimated from a measurement of the head loss between the inlet and outlet of the filter, is used in the operations (iv) and (v) at an instant *t* different from the initial instant.

7. A method according to one of claims 1 to 6, characterized in that the measurement of the operating parameters of the engine includes the stages comprising:

- sensing the speed Ne of revolution of the engine, by using a speed sensor (6),
- sensing the engine load Q, by using a load sensor (7).

8. The use of the determination method according to one of the preceding claims to monitor and/or control a method for management of the regeneration of a particle filter of a motor vehicle.

9. The use according to claim 8, in which the determination method is used when the temperature at the inlet of the filter is between approximately 250°C and 500°C.

10. The use of the determination method according to one of claims 1 to 7 in a method for management of the regeneration of a particle filter of a motor vehicle, to determine, for each operating point of the engine of a vehicle, a threshold mass of particles, below which the filter will tend to become loaded with particles and above which the rate of combustion of the particles in the filter will tend to increase.